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CHEMISTRY, A TRADE OR A PROFESSION?

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The Question Asked.

With the god Mars as his press-agent, the chemist has recently been advertised until a wave of interest in his occupation has swept over the country. Young men, young women, and especially their ambitious parents, are asking us with ever-increasing frequency, "What is a chemist?"

The Problem Studied.

That this question might be answered more intelligently in connection with local conditions, a survey of the chemical industries of Nashville (exclusive of educational institutions) was begun, especial attention being given to the amount of chemical knowledge and training required of the workers, together with their opportunities for advancement along chemical lines. Conversations were had with workers and executives, and statistical data recorded on a suitable questionnaire. Many helpful suggestions were received from Professor R. W. Selvidge, department of industrial arts, George Peabody College for Teachers, based on his past experience in certain extensive government surveys.

Nashville is a city of over 150,000 population, with diversified manufacturing interests, which, at the time of this survey (winter of 1917–1918), included no overshadowing industry. The many plants visited may be grouped into 22 different types, each employing some chemical process, or operating under chemical control. It is likely that similar plants and conditions would be found in almost any city of similar size.

Two Schools for Chemists.

Some chemists go to college, others only to "the school of experience." Ten types of industries in Nashville employ the college man exclusively—nine use the man with "experience only"—in three types are both classes at work. Only two workers were found who had studied high school chemistry but no further—the nature of their work, however, placed them in the "experience only" group.

Choosing Between the Trained and Untrained Chemist.

The employment of a trained chemist depends principally upon two conditions:

1. The size of the plant. The prime function of a chemist, in controlling the operation of a plant, is to effect economies in the process. If it be true that large plants have large wastes, then smaller plants have smaller wastes in the rough proportion of their respective sizes. A plant may be so small that it is cheaper to run wastefully than to employ a chemist.

2. The attitude toward "passable quality." Much of the production observed during this survey was obviously intended for consumers with whom quality was a secondary consideration. It is undoubtedly legitimate to attempt to supply this demand. Such products need not be carefully standardized and there need be but little variation or improvement in the method of manufacture. There is, indeed, little incentive to the manufacturer to improve the quality of his product, especially if it means added expense, with no corresponding increase in selling price advisable.

None of the plants visited in this survey, in which men with "experience only" were employed as chemical workers, were of great size. But whether size made scientific management possible, or whether scientific management would produce the size, was never wholly settled by my discussions with executives,

A Comparison of the Workers.

Discussion, questioning and observation furnished a basis for a comparison of the advantages and opportunities of the workers of each group.

I. *Advantages of the Man with College or Technical School Training, Plus Experience.*

1. He can judge the efficiency of newly suggested processes, without costly experimentation. The history of industry is full of examples where men have wasted great amounts of time and material in trying to determine a formula or method by "trial and error." The trained chemist will at once detect anything which is fundamentally wrong with a new plan.

2. He can change to new methods and formulae with little confusion. No change is absolutely new to the trained chemist. He will also be able to distinguish between changes which are fundamental in the process, and those which are accessory only.

3. He can test, purify and utilize crude materials. Crude materials are never uniform, and wherever used, definite quantitative analyses are necessary. It often happens that very small amounts of certain impurities are exceedingly deleterious to a process, and just as frequently, large amounts of other impurities are of no significance. The trained chemist will know the proper methods of treatment in each case.

4. He can originate new processes and products, especially in the utilization of by-products. The spirit of research is always present in the work of a trained chemist. He has had opportunity to realize the enormous mass of chemical knowledge, and the view which he has taken of the breadth of the science has greatly widened his horizon. He is able to more clearly judge what additional products may be needed in his field of manufacture, and what materials will serve.

5. He profits rapidly and extensively from experience. A fact learned in experience is immediately measured by a principle learned in theory, and the fundamentals and accessories of a process properly judged. Related phenomena are connected with each other, no matter how different they may appear.

6. He is more likely to properly handle an emergency. Having a knowledge of the real nature of the process, he can more accurately diagnose troubles of operation, and with his wider field of information, even though much of it be theoretical, he may, if necessary, make use of more complex remedies for the difficulties than would be possible if his knowledge were limited to one line of experience.

Opportunities of the Man with College or Technical School Training, Plus Experience.

1. He is eligible for promotion to research in his field. A firm theoretical knowledge is indispensable in research, both in its planning and in its interpretation. Advanced commercial work—any chemical work, in fact, which is above pure routine—is essentially research.

2. He will find it comparatively easy to accept a position in a field different from that in which he is now engaged. The work will not be absolutely new—he knows the theory of the process already, and can rapidly gain experience.

3. He is available as an instructor in his special branch, or an allied branch of the science. A broad knowledge is fundamental to proper instruction.

4. With college or technical-school training in chemistry, he is equipped for advanced study and employment in other profitable sciences, *e. g.*, agriculture, medicine, geology, etc.

II. *Disadvantages of the Man with "Experience Only."*

1. He can not judge the efficiency of new processes, without costly experimentation. Having no theoretical conceptions, he can only "guess ahead," and determine by trial the correctness or error of his estimates.

2. He can not easily change to new formulae and methods.

Everything which he has not actually experienced is new to him. In attempting to understand a new process, he can not distinguish between the essential principles, which admit of no variation, and the lesser details, which might be radically altered to suit local conditions.

3. He can not test, purify or utilize crude materials. He must purchase purified materials, at whatever price their manufacturer may ask. The purity of his product is dependent upon the responsibility of other persons, over whom he has no control, and on whom he has no method of check. He may pay a high price for these imported articles, when quantities, almost as suitable, are at his very door.

4. He can not originate new processes and products. If he has the desire, he is likely to hesitate, because he can not be sure of his grounds. He is not familiar with his own field to its limits, much less is he willing to venture into unknown paths. This spirit was almost universal with the workers of this type in Nashville, who unhesitatingly pronounce their methods "the best," and declare that they know all they need to know.

5. He does not profit as rapidly and extensively by experience as does the trained man. He possesses nothing upon which to hang his fabric of experience—he must learn facts and manipulations in isolated sequence. He receives, after the lapse of sufficient time, a dexterity and familiarity in relation with the one process with which he is concerned which makes him an acceptable workman where the requirements are not rigorous.

6. An emergency is likely to present conditions which he will be unable to diagnose. His training is essentially one which serves only so long as the process is going smoothly. Makeshifts, substitutes and optional methods, unless obviously applicable, have probably not come within the range of his experience. In such a case, the services of an expert will of necessity be sought.

Opportunities of a Man with "Experience Only."

1. He soon reaches the limit of his scientific growth. As far as the actual manipulations of a certain process are concerned, his skill does not appreciably increase after a few months. He is not available for a position of research, as his knowledge is limited to his own experience.

2. The future for the rule-of-thumb paint mixer, the "ammonia man" at the gas factory, and others of similar employment, holds but little promise. Chemical routine is never remunerative. Why should it be? If financial reward is in any way based on the amount of intelligent effort necessary to

achieve success, what particular claims have these occupations which are quickly learned, and easily carried on—in which effort and study have been neither intensive nor extensive!

3. He is not an effective instructor, even concerning the processes with which he is familiar. He may be able to answer the question "How?" but can not explain the "Why?" of his methods. He can do a thing, while an apprentice watches and observes, but he can rarely explain clearly what he is doing. In my inquiries, this fact was noticed many times.

4. In some industries it is possible for the worker, after showing some abilities of an executive nature, to be advanced to a position of executive responsibility. But such is not the logical or the usual sequence. This is especially true of persons engaged in purely routine chemical work. The curse of rule-of-thumb training, so often, by a most egregious error misnamed "practical," is that it leads the worker into a blind alley occupation, in which he can soon reach the limit of his progress, and then go no further.

Chemistry, a Trade or a Profession?

Chemistry is distinctly a *profession,* rather than a *vocation.* It is to be classified with medicine, law and engineering, rather than with carpentry, bricklaying or plumbing. In a profession, more than an elementary study of its principles is necessary for efficiency, while in a vocation, the direct experience of labor, rather than theoretical study, makes a master of the trade. In a profession, one must show evidence of training in a recognized school, and be the possessor of degrees of proper kind, before he is accepted by his colleagues as a fellow. In a vocation, however, recognition is given to experience only—the schools which teach electroplating, photo-engraving, sign-painting, carpentry, plumbing, bricklaying, etc., being neither numerous nor largely patronized by the workers. It is apparent from the survey of the chemical industries of Nashville, that there are two recognized groups of workers—those who, after college or technical training, are properly designated as chemists, and those who, with experience only, may be recognized only as chemical artisans, more or less skilled.

Therefore, "What is a chemist?" A man or woman of considerable educational attainments, versed in the history, literature, ethics and current progress of his cult, feeling the same pride in his life work which is common to all members of the "learned professions."